

**General Certificate of Secondary Education**

**A624**

**Engineering**

Engineering for Sustainability

**Specimen Paper**

Time: 1 hour

Candidates answer on the question paper.

**Additional materials:**

Candidate  
Forename

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Candidate  
Surname

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Centre  
Number

--	--	--	--	--	--	--	--	--	--

Candidate  
Number

--	--	--	--	--	--	--	--	--	--

## INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each answer carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do not write in the bar codes.
- Do not write outside the box bordering each page.
- Write your answer to each question in the space provided.

## INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 60.

For Examiner's Use Only			
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
9			
TOTAL			

This document consists of **10** printed pages and **2** blank pages.

**[Turn over**

Answer **all** questions.

1 For each product select from the sector shown in which it is made.

Sectors:

- Automotive
- Chemical & Process
- Computers, Communication and IT
- Aerospace
- Medical and Pharmaceutical

Product:

Road bridge.....

Washing up liquid.....

Personal Digital Assistant (PDA).....

Car seat.....[4]

2 For each product select from the sector shown in which it is made.

Sectors:

- Aerospace
- Rail and Marine
- Medical and Pharmaceutical
- Electrical and Electronics
- Structural and Civil

Product:

Powered wheelchair.....

Turbine.....

Navigation system.....

Security system.....[4]

3 Tick **one** product from the list and state:

- **one** technology used in your chosen product; and
- **one** benefit of using that technology.

Product:

- ☐ car seat
- ☐ personal digital assistant PDA
- ☐ powered wheelchairs
- ☐ navigation system
- ☐ turbine
- ☐ security system
- ☐ washing up liquid
- ☐ road Bridge

Technology.....[1]

Benefit.....[1]

4 Name **two** tools or items of equipment **you** have used to make an engineered product.

Engineered Product.....

Tool/equipment 1.....[1]

Tool/equipment 2.....[1]

5 Name **two** engineering materials **you** have used to make an engineered product.

Engineered Product.....

Material 1.....[1]

Material 2.....[1]

6 State what the letters **CAD** stand for.

C..... A..... D.....[1]

7 Describe **two** benefits to a company of using CAD when **designing** engineered products.

Benefit 1.....

.....

.....[2]

Benefit 2.....

.....

.....[2]

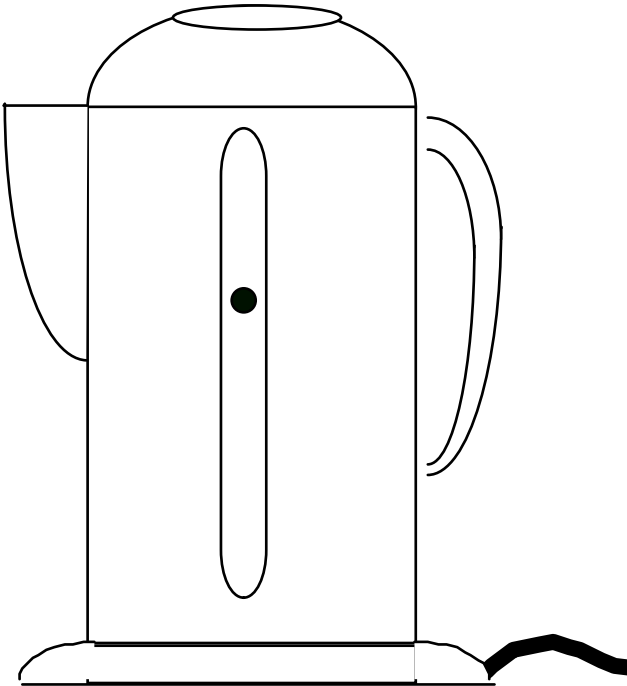
8 Describe **one** benefit to **users** of engineered products designed using CAD.

.....

.....

.....[2]

- 9 Look at the features listed and identify how they contribute to *design for the environment* by adding the features into appropriate boxes below



#### FEATURES

Injection moulded body

Volume indicator

Clips join body parts

Insulated outer wall

Efficient ceramic disc heat element

Use of recyclable materials

Reduce product energy consumption

1

2

3

Design for disassembly

[5]

- 10 Tick **two** recyclable materials.

- ☐ GRP
- ☐ brass
- ☐ epoxy resin
- ☐ HDPE
- ☐ melamine
- ☐ PET

[2]

- 11 Describe **one different** environmental consideration for each engineering process shown below.

Material removal.....  
.....  
.....[2]

Heat treatment.....  
.....  
.....[2]

Surface finishing.....  
.....  
.....[2]

- 12 Describe **one** way *designing for the environment* benefits a company manufacturing hazardous waste.

.....  
.....  
.....[2]

- [6]

SPECIMEN

**14** Tick **one** of the aims of design for the environment given below and explain how **one** engineered product you have studied meets that aim.

Aims of design for the environment:

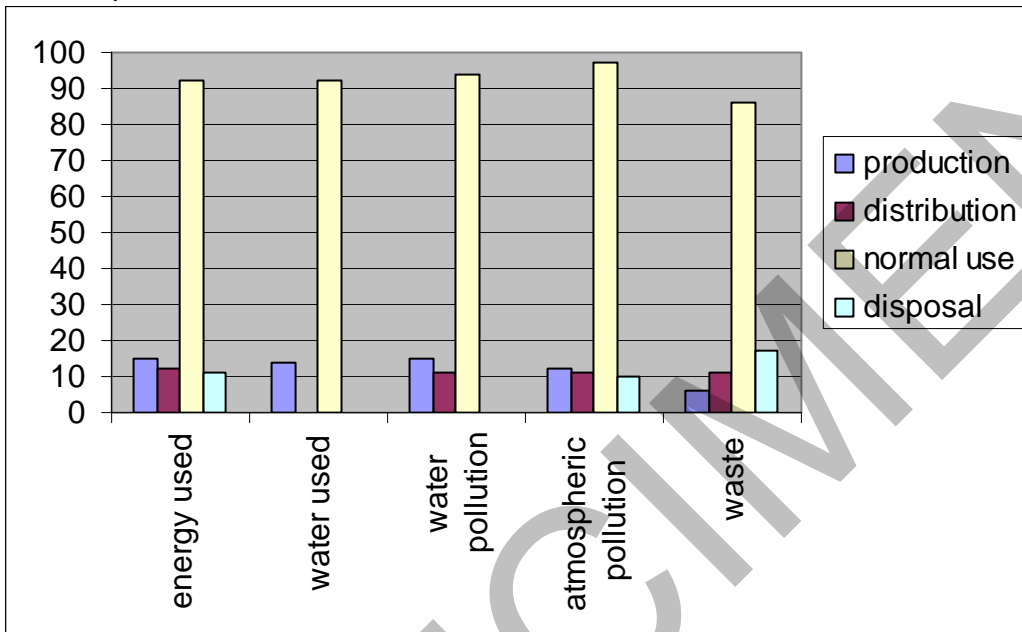
- ☐ Use of clean technologies
- ☐ Use of recycled material and reused components

[4]



**15** The chart shows how much of the total environmental impact of an engineered product comes from its:

- production;
- distribution;
- normal use; and
- disposal.



**(a)** Tick the correct answer to show whether each of the following statements is true or false.

	True	False
More waste came from production than disposal.		
Production of the product caused more pollution than its normal use.		
Most of the environmental impact of the product came during its normal use.		
More energy was used in disposal than in production.		

**[4]**

**16** Describe **one** example of water pollution caused by an engineered product in normal use.

[2]

Describe how **one** engineered product has been modified to reduce the atmospheric pollution it causes in normal use.

[2]

**17** Please note that the instruction ‘discuss’ means that you should:

- identify **three** relevant issues/points raised by the question;
- explain why you consider **two** of these issues to be relevant;
- use **one** specific example or piece of evidence to support your answer.

Discuss the impact of control technology on designing for the environment.

Blank handwriting practice lines with a large, faint watermark 'S' in the top left corner.

.....

.....

.....[6]

**Total Marks: [60]**

SPECIMEN

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SPECIMEN

The maximum mark for this paper is 60.

SPECIMEN

Question Number	Answer	Max Mark																																			
1	<p>For each product select from the sector shown in which it is made.</p> <p>Sectors:</p> <ul style="list-style-type: none"><li>Automotive</li><li>Chemical &amp; Process</li><li>Computers, Communication and IT</li><li>Aerospace</li><li>Medical and Pharmaceutical</li></ul> <p>Road bridge .....</p> <p>Washing up liquid .....</p> <p>Personal Digital Assistant (PDA) .....</p> <p>Car seat .....</p> <p>One mark for each correct answer.</p> <table><tr><th>Product</th><th>Road Bridge</th><th>Washing up liquid</th><th>PDA</th><th>car seat</th></tr><tr><td>Sector</td><td></td><td></td><td></td><td></td></tr><tr><td>Automotive</td><td></td><td></td><td></td><td>X</td></tr><tr><td>Chemical &amp; Process</td><td></td><td>X</td><td></td><td></td></tr><tr><td>Computers Communication and IT</td><td></td><td></td><td>X</td><td></td></tr><tr><td>Aerospace</td><td></td><td></td><td></td><td></td></tr><tr><td>Structural and Civil</td><td>X</td><td></td><td></td><td></td></tr></table>	Product	Road Bridge	Washing up liquid	PDA	car seat	Sector					Automotive				X	Chemical & Process		X			Computers Communication and IT			X		Aerospace					Structural and Civil	X				
Product	Road Bridge	Washing up liquid	PDA	car seat																																	
Sector																																					
Automotive				X																																	
Chemical & Process		X																																			
Computers Communication and IT			X																																		
Aerospace																																					
Structural and Civil	X																																				

[4]

Question Number	Answer	Max Mark																																			
2	<p>For each product select from the sector shown in which it is made.</p> <p>Sectors:</p> <ul style="list-style-type: none"><li>• Aerospace</li><li>• Rail and Marine</li><li>• Medical and Pharmaceutical</li><li>• Electrical and Electronics</li><li>• Structural and Civil</li></ul> <p>Powered wheelchair .....</p> <p>Turbine .....</p> <p>Navigation system .....</p> <p>Security system .....</p> <p>1 mark for each correct answer.</p> <table><tr><th>PRODUCT</th><th>Powered wheelchair</th><th>Turbine</th><th>Navigation system</th><th>Security system</th></tr><tr><td>SECTOR</td><td></td><td></td><td></td><td></td></tr><tr><td>Aerospace</td><td></td><td>X</td><td></td><td></td></tr><tr><td>Rail and Marine</td><td></td><td></td><td>X</td><td></td></tr><tr><td>Medical and Pharmaceutical</td><td>X</td><td></td><td></td><td></td></tr><tr><td>Electrical and Electronics</td><td></td><td></td><td></td><td>X</td></tr><tr><td>Structural and Civil</td><td></td><td></td><td></td><td></td></tr></table>	PRODUCT	Powered wheelchair	Turbine	Navigation system	Security system	SECTOR					Aerospace		X			Rail and Marine			X		Medical and Pharmaceutical	X				Electrical and Electronics				X	Structural and Civil					
PRODUCT	Powered wheelchair	Turbine	Navigation system	Security system																																	
SECTOR																																					
Aerospace		X																																			
Rail and Marine			X																																		
Medical and Pharmaceutical	X																																				
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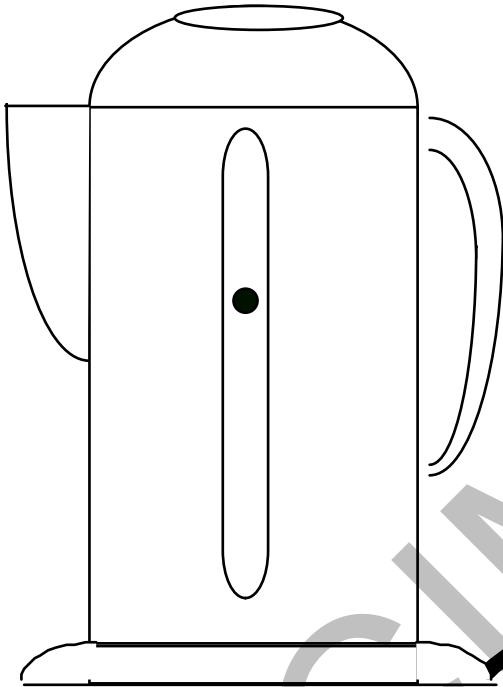
[4]

Question Number	Answer	Max Mark
3	<p><b>Tick one product from the list and state: one technology used in your chosen product; and one benefit of using that technology.</b></p> <p><b>Product:</b></p> <p><input type="checkbox"/> car seat</p> <p><input type="checkbox"/> personal digital assistant PDA</p> <p><input type="checkbox"/> powered wheelchairs</p> <p><input type="checkbox"/> navigation system</p> <p><input type="checkbox"/> turbine</p> <p><input type="checkbox"/> security system</p> <p><input type="checkbox"/> washing up liquid</p> <p><input type="checkbox"/> road Bridge</p> <p><b>Technology</b> .....[1]</p> <p><b>Benefit</b> .....[1]</p> <p>No marks for selecting a product. For the selected product, one mark for stating a technology used in the product, and one for a benefit. For example <b>technology</b>:</p> <p><u>Car seat</u> memory foam, electronic adjustment, driver setting memory,  <u>Personal digital assistant</u> microchip/microelectronics,surface mounting  <u>Powered wheelchairs</u> as car seat, mouth/eye/control  <u>Navigation system</u> satellite/  <u>Turbine</u> digital control  <u>Security system</u> LEDs, wireless comms,  <u>Washing up liquid</u> thickeners, antibacterial  <u>Road bridge</u> CAD design/test,  <b>Benefit</b> examples:  Increased user comfort/security  Increased strength/ smaller item, less weight.\accept product features.</p>	[2]



Question Number	Answer	Max Mark
4	<p><b>Name two tools or items of equipment you have used to make an engineered product.</b></p> <p><b>Engineered Product</b> .....</p> <p><b>Tool/equipment 1</b> .....[1]  <b>Tool/equipment 2</b> .....[1]</p> <p>No marks for product, one mark for each of two specifically named engineering tools or items of engineering equipment.  Eg (vernier/outside/inside.) calipers, hacksaw, engineer's square, feeler gauge, centre punch, cold chisel, engineer's vice, named file, named hammer.</p>	[2]
5	<p><b>Name two engineering materials you have used to make an engineered product.</b></p> <p><b>Engineered Product</b> .....</p> <p><b>Material 1</b> .....[1]  <b>Material 2</b> .....[1]</p> <p>(b) No marks for product, one mark for each of two specifically named materials used in the product. For example:  Aluminium alloy, low carbon steel,</p>	[2]
6	<p><b>State what the letters CAD stand for.</b></p> <p><b>C</b> ..... <b>A</b> ..... <b>D</b> .....</p> <p>One mark for Computer Aided Design</p>	[1]

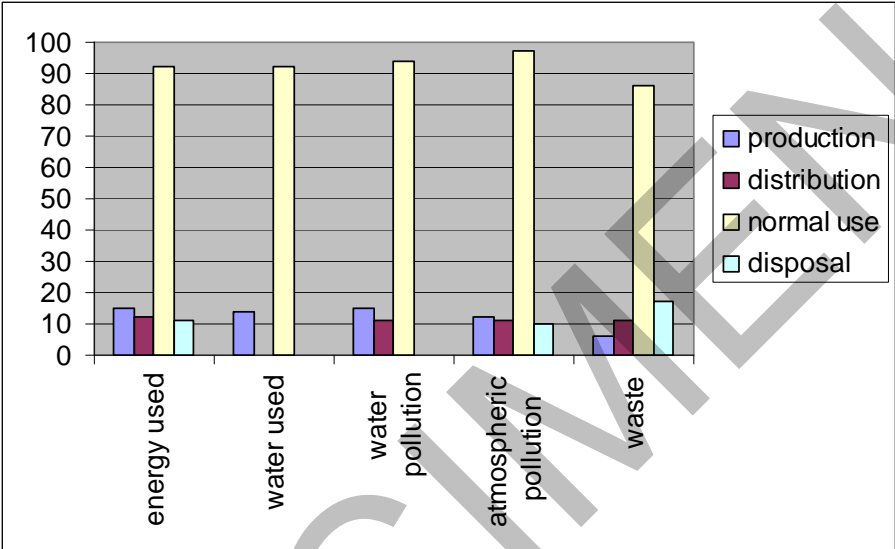
Question Number	Answer	Max Mark
7	<p><b>Describe two benefits to a company of using CAD when designing engineered products.</b></p> <p><b>Benefit 1</b> .....</p> <p>.....</p> <p>.....[2]</p> <p><b>Benefit 2</b> .....</p> <p>.....</p> <p>.....[2]</p> <p>Two marks for each of two benefits described, for example a feature and why or how it is beneficial to a company:          Designs can be sent electronically saving time and postage. Designs can be amended without redrawing, saving time. 2D drawings can be viewed as 3D objects, stress/load calculations can be carried out automatically.</p>	[4]
8	<p><b>Describe one benefit to users of engineered products designed using CAD.</b></p> <p>Two marks for a benefit to the user, with why or how, as above, for example:          Customised products more available/can be made by amending CAD files and sending to CAM.          Designs are tested as models so finished product more reliable.          Calculations can be carried out on design so can optimise designs to use less material – lighter products, lower transport costs – cheaper product.          New/improved products available quicker.          One mark for single point eg faster</p>	[2]

Question Number	Answer	Max Mark
9	<p>Look at the features listed and identify how they contribute to <i>design for the environment</i> by adding the features into appropriate boxes below</p> <div>  <p><b>FEATURES</b></p> <p>Injection moulded body</p> <p>Volume indicator</p> <p>Clips join body parts</p> <p>Insulated outer wall</p> <p>Efficient ceramic disc heat element</p> </div> <div> <div> <p><b>Use of recyclable materials</b></p> </div> <div> <p><b>Reduce product energy consumption</b></p> <p>1</p> <p>2</p> <p>3</p> </div> <div> <p><b>Design for disassembly</b></p> </div> </div> <p>           One mark for each of 5 correctly placed features:            Injection moulded body (urm)            Volume indicator(rpec)            Clips join body parts(dfd)            Insulated outer wall(rpec)            Efficient ceramic disc heat element(rpec)         </p>	[5]

Question Number	Answer	Max Mark
10	<p><b>Tick two recyclable materials.</b></p> <p> <input type="checkbox"/> GRP  <input type="checkbox"/> brass  <input type="checkbox"/> epoxy resin  <input type="checkbox"/> HDPE  <input type="checkbox"/> melamine  <input type="checkbox"/> PET         </p> <p>One mark each for brass and HDPE</p>	[2]
11	<p><b>Describe one different environmental consideration for each engineering process shown below.</b></p> <p><b>Material removal</b></p> <p><b>Heat treatment</b></p> <p><b>Surface finishing</b></p> <p>In each of 3 parts, two marks for a clear description of what needs to be considered with how or why. Different in each case. For example:</p> <p><u>Material removal</u> : eg          Energy used by different processes or          can material removed be re-used/sold or how disposed or          will hazardous dust/fumes be formed from the process.</p> <p><u>Heat treatment</u>          Energy used by different process          Health and Safety issues for workforce or          will hazardous fumes/waste be formed.</p> <p><u>Surface finishing</u>          Energy used by process          will hazardous dust/fumes be formed.</p>	<p>[2]</p> <p>[2]</p> <p>[2]</p>

Question Number	Answer	Max Mark
12	<p><b>Describe one way <i>designing for the environment</i> benefits a company manufacturing engineered products.</b></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Two marks for a description of a benefit to a company, for example:  Reducing energy/material used (1) or increasing efficiency (1) reduces the company's costs (1). A reputation(1) for design for the environment will attract customers who see themselves as green(1)/ want products with a smaller carbon footprint (1) or similar.</p>	[2]
13	<p><b>One issue considered when <i>designing for the environment</i> is <i>manufacture without producing hazardous waste</i>. Explain in detail how a designer can address this issue.</b></p> <p>Six marks for a detailed explanation, including, for example:  At each stage of the design process (1) consider materials (1) and manufacturing methods (1) checking whether any of the options considered could potentially cause hazardous waste (1) select materials(1) that do not give rise to HW when they were produced)(1) or when worked. Consider disposal methods (1)/potential for recycling.</p>	[6]

Question Number	Answer	Max Mark
14	<p><b>Tick one of the aims of design for the environment given below and explain how one engineered product you have studied meets that aim.</b></p> <p><b>Aims of design for the environment</b></p> <p><input type="checkbox"/> <b>Use of clean technologies</b></p> <p><input type="checkbox"/> <b>Use of recycled material and reused components</b></p> <p>No mark for selecting one aim.  Four marks for a detailed explanation using a product as illustration.  Guidance: one mark for each relevant point linking the product with the aim.</p> <p><u>Use of clean technologies</u>  Clean burn engines. wind power, solar power, hydropower, electric motors – applied to (product)</p> <p><u>Use of recycled material and reused components</u>  Recycled plastics used in public seating, polyester fleece made from PET drinks bottles.</p>	<b>[4]</b>

Question Number	Answer	Max Mark																														
15	<p>The chart shows how much of the total environmental impact of an engineered product comes from its:</p> <ul style="list-style-type: none"><li>• production;</li><li>• distribution;</li><li>• normal use; and</li><li>• disposal.</li></ul> <div><table><thead><tr><th>Category</th><th>production</th><th>distribution</th><th>normal use</th><th>disposal</th></tr></thead><tbody><tr><td>energy used</td><td>15</td><td>12</td><td>92</td><td>11</td></tr><tr><td>water used</td><td>14</td><td>10</td><td>92</td><td>10</td></tr><tr><td>water pollution</td><td>15</td><td>12</td><td>92</td><td>11</td></tr><tr><td>atmospheric pollution</td><td>13</td><td>11</td><td>96</td><td>10</td></tr><tr><td>waste</td><td>8</td><td>10</td><td>85</td><td>17</td></tr></tbody></table></div> <p>Tick the correct answer to show whether each of the following statements is true or false.</p> <p>One mark for each correct response:</p> <p>False</p> <p>False</p> <p>True</p> <p>False</p>	Category	production	distribution	normal use	disposal	energy used	15	12	92	11	water used	14	10	92	10	water pollution	15	12	92	11	atmospheric pollution	13	11	96	10	waste	8	10	85	17	
Category	production	distribution	normal use	disposal																												
energy used	15	12	92	11																												
water used	14	10	92	10																												
water pollution	15	12	92	11																												
atmospheric pollution	13	11	96	10																												
waste	8	10	85	17																												

[4]

Question Number	Answer	Max Mark
16	<p><b>Describe one example of water pollution caused by an engineered product in normal use.</b></p> <p>two marks for description including a named product that gives rise to polluted water in normal use (1) and the type of contamination(1):  Eg washing machines produce water contaminated with detergent.  Cars when washed – water polluted with particulates, grime oils etc.  NOT at the end of the products useful life, or unintended use (eg oil slicks from stricken tankers etc)</p> <p><b>Describe how one engineered product has been modified to reduce the atmospheric pollution it causes in normal use.</b></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>two marks for a description of how a named product has had its atmospheric pollution in normal use reduced.  One only for stating a technology (eg engine management systems, catalytic converter) or an advanced product (Dual fuel car).</p>	<p>[2]</p> <p>[2]</p>



Question Number	Answer	Max Mark
17	<p><b>Please note that the instruction ‘discuss’ means that you should:</b></p> <ul style="list-style-type: none"> <li>• identify three relevant issues/points raised by the question;</li> <li>• explain why you consider two of these issues to be relevant;</li> <li>• use one specific example or piece of evidence to support your answer.</li> </ul> <p><b>Discuss the impact of control technology on designing for the environment.</b></p> <p>Discuss the impact of control technology on designing for the environment.</p> <p>Six marks for a discussion giving 3 relevant points, stating why 2 are relevant and giving an example. Or</p> <p>For critical evaluation of the impact (showing understanding of designing for the environment).</p> <p>Control technology (1 mark for what is being controlled) related to any of the following for a further mark:</p> <ul style="list-style-type: none"> <li>• manufacture without producing hazardous waste</li> <li>• use of clean technologies</li> <li>• reduce product chemical emissions</li> <li>• reduce product energy consumption</li> <li>• use of non-hazardous recyclable materials</li> <li>• use of recycled material and reused components</li> <li>• design for ease of disassembly</li> <li>• product reuse or recycling at end of life.</li> </ul>	[6]
	Paper Total	[40]

## Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1	4	0	0	4
2	4	0	0	4
3	2	0	0	2
4	0	2	0	2
5	0	2	0	2
6	1	0	0	1
7	4	0	0	4
8	2	0	0	2
9	5	0	0	5
10	0	2	0	2
11	0	6	0	6
12	0	0	2	2
13	0	6	0	6
14	0	4	0	4
15	0	0	4	4
16	2	0	2	4
17	0	0	6	6
<b>Totals</b>	24	22	14	60